

## 14.—The Callionymidae of Western Australia (Pisces)

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In Western Australian waters the Callionymidae are represented by two genera and nine species: *Dactylopus* with one species and *Callionymus* with eight species. A key for their identification is given and their distribution and synonymy are discussed.

### Introduction

Thanks to McCulloch's (1923, 1926) beautifully illustrated revisions, the Callionymidae of Australia are systematically an easily accessible and comparatively well-known group. However, several of the species described by McCulloch were known from single specimens only, and their known distribution was limited to the type localities.

From Western Australia, McCulloch (1929-1930) knew four species: *Dactylopus dactylopus*, *Callionymus calauropomus*, *C. calcaratus*, and *C. apricus*. In subsequent years Whitley (1944, 1945) added *C. goodladi* (a new species), and *C. papilio* to the State list, bringing the total number to six (Whitley 1948b). Very recently I was able to record another two species (Mees 1959). Even this increased number of eight species does not complete the state list, for amongst material recently received by the Western Australian Museum are several specimens of yet another species.

The purpose of this paper is to give a key to the species of Callionymidae known from Western Australia, as well as additional information, mainly on their distribution. It has further been possible to synonymise two names which had been given as a consequence of insufficient knowledge of sexual dimorphism.

It is possible that for some of the species listed here older names will be found to be available when Australian material is compared with species described from the East Indies and the Philippines. Major revisional work, however, goes beyond the scope of this small contribution.

The bulk of the material this study is based on was provided by Mr. R. J. McKay of the Fisheries Department, and by Messrs. W. and W. Poole, owners of the "Bluefin". Mr. G. Mack, director of the Queensland Museum, Brisbane, sent on loan a cotype of *Callionymus grossi* Ogilby and specimens of *C. limiceps* Ogilby. Mr. I. S. R. Munro, of the C.S.I.R.O. Laboratory of Fisheries and Oceanography, Cronulla, N.S.W., sent on loan his whole collection of Callionymidae which includes many specimens from Western Australia. Mr. G. Palmer allowed me, during a visit to the British Museum (Natural History) in May 1962, to examine the specimen of *C. grossi* from the Monte Bello Islands recently recorded by him. Mr. T. D. Scott,

South Australian Museum, provided some specimens from South Australia, amongst which *Callionymus papilio*, a species of which no material from Western Australia was available. Mr. G. P. Whitley gave information on material of *C. calcaratus* in the Australian Museum, Sydney.

In the list of material examined, numbers preceded by a P refer to specimens in the collection of the Western Australian Museum, numbers preceded by A and C are in the C.S.I.R.O. collection, Cronulla.

### Key to the Genera known from Western Australia

- 1a. Spine and first ray of ventrals separated from the rest of the fin ..... *Dactylopus*
- b. Ventrals without detached rays ..... *Callionymus*

### Genus *Dactylopus* Gill \*

*Dactylopus* Gill, Proc. Acad. Nat. Sci. Philad., 1859, p. 130—type by monotypy, *D[actylopus] Bennetti* Gill = *Callionymus dactylopus* Valenciennes.

*Vulsus* Günther, Cat. Fish. Brit. Mus. III, 1861, p. 151—nomen novum for *Dactylopus* Gill, allegedly preoccupied.

Characterised by the detached spine and first ray of the ventral fin. Though this character is very useful and convenient for identifying the species, it seems hardly of generic value; however, the preopercular spine is also different from that of any other species I have seen, and as the genus has now been generally accepted for a century, I prefer to maintain it.

Only one species known.

### *Dactylopus dactylopus* (Valenciennes)

*Callionymus dactylopus* Valenciennes, in Cuvier & Valenciennes, Hist. Nat. Poiss. XII, 1837, p. 232—no locality.

*Dactylopus Bennetti* Gill, Proc. Acad. Nat. Sci. Philad., 1859, p. 130—nomen novum for *Callionymus dactylopus* Valenciennes, proposed to avoid tautonomy.

*Dactylopus dactylopus*; Ogilby, Ann. Qd Mus. 9, 1908, p. 38 (Moreton Bay, Queensland); Ogilby, Proc. Roy. Soc. Qd 23, 1910, p. 46 (Stradbroke Island and Wynnum in South-Eastern Queensland, and Moreton Bay, Queensland); McCulloch, Zool. Res. Endeavour III, 1915, p. 149, pl. XXVIII (Shark Bay, Western Australia, and off Hervey Bay, Queensland); McCulloch & Whitley, Mem. Qd Mus. 8, 1925, p. 173 (Queensland: Moreton Bay, Stradbroke Island, Wynnum, off Hervey Bay); McCulloch, Mem. Aust. Mus. 5, 1929, p. 337 (Queensland, Western Australia); Whitley, W. Aust. Fish. Dept., Fish. Bull. 2, 1948, p. 27 (Western Australia); de Beaufort & Chapman, Fish. Indo-Aust. Arch. IX, 1951, p. 80 (Western Australia, Queensland).

Diagnostic characters. D IV-8½, A 7½, P ii.15.ii or ii.15.iii, or ii.16.ii, sometimes i.15.ii or i.16.iii, V I. 1-4, C ii.7.ii or ii.7.iii; soft rays of dorsal fin divided except the first one which may be

\* Synonymy throughout this paper is confined to Australian records.

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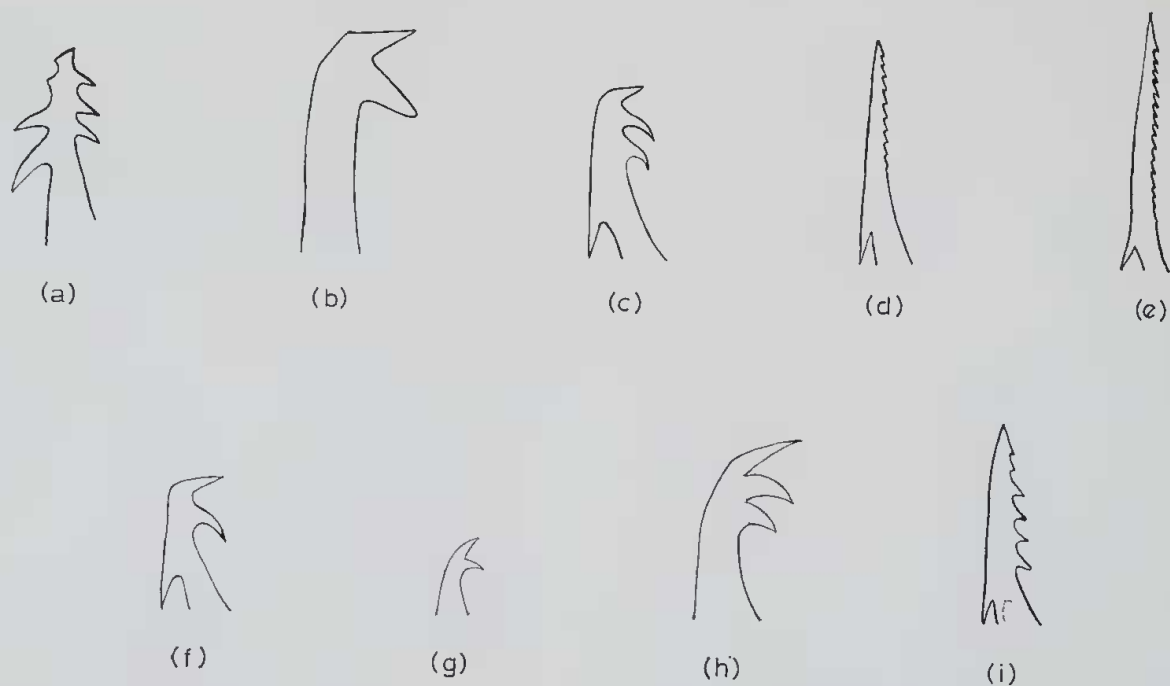


Fig. 1.—Right preopercular spines. (a) *Dactylopus dactylopus* (P 5263, standard length 129 mm), (b) *Callionymus calauropomus* (P 4563, s. l. 180 mm), (c) *C. calcaratus* (P 5392, s. l. 154 mm), (d) *C. goodladi* (P 5440, s. l. 118 mm), (e) *C. grossi* (P 5400, s. l. 128 mm), (f) *C. limiceps* (P 5407, s. l. 131 mm), (g) *C. papilio* (F 3076, s. l. 62 mm), (h) *C. phasis* (from literature), (i) *C. rameus* (P 5431, s. l. 129 mm). The spines of *C. calauropomus* and *C. phasis*, which are curved upwards, are shown in lateral view, the others in dorsal view.  $2\frac{1}{2}$  x natural size.

either simple or divided; origin of D 1 in advance of a line connecting the gill openings; preopercular spine with on each side three to five hooks (Fig. 1a); usually first and second rays of pectoral undivided, sometimes only the first.

**Distribution.** A widely distributed species, known from the Philippines, the East Indies, Queensland and Western Australia. In Western Australia known from Exmouth Gulf, Shark Bay, and the Perth area, from Scarborough to Point Peron. The species apparently reproduces at City Beach: in the aquarium of Mr. V. A. Dawson of Como I have seen several live specimens of less than 5 cm length, caught on a sandy bottom in shallow water at that locality.

Material examined, 43 specimens, varying in standard length from 64 to 150 mm. Exmouth Gulf (C 2319, C 2342, C 2363, C 2364, C 2381, C 2382, C 2383, P 4378, P 4952, P 5102 (3 sp.), P 5352, P 5367 (2 sp.) P 5368, P 5422), Shark Bay (P 4368, P 4375 (2 sp.), P 5451, P 5454), north of Peron Flats, Shark Bay (P 5268), between Kck's Island and Point Quobba, Shark Bay (P 4279), Entrance Denham Channel, Shark Bay (C 572), Palm Beach, Scarborough (P 4354, P 4715), Fremantle (P 752), Swan River (P 3096, P 3097), Woodman's Point (P 5494), Naval Base (P 1226, P 5501), Rockingham (P 1227, P 2050, P 2060, P 2061, P 2062, P 4359, P 4684), Rockingham Bay (P 5223), Garden Island (P 4691), Point Peron (P 996). Also examined one specimen from three to four miles east of Burnett River, Queensland (A 915).

#### Genus *Callionymus* Linnaeus\*

*Callionymus* Linnaeus, Syst. Nat. 10th ed. I, 1758, p. 249—based on *C. Lyra*, *C. dracunculus*, and *C. indicus*. *C. lyra* is generally accepted as type.

\* *Callimucenus* Whitley is also a synonym.

*Calliurichthys* Jordan & Fowler, Proc. U.S. Nat. Mus. 25, 1903, p. 941—type by original designation, *Callionymus japonicus* Houttuyn.

*Repomucenus* Whitley, Aust. Zool. 6, 1931 (Feb. 13), p. 323—type by original designation and monotypy, *Callionymus calcaratus* Macleay.

*Foetorepus* Whitley, Aust. Zool. 6, 1931 (Feb. 13), p. 323—type by original designation, *Callionymus calauropomus* Richardson.

*Yerutius* Whitley, Rec. Aust. Mus. 18, 1931 (March 25), p. 115—type by original designation, *Callionymus apricus* McCulloch = *Callionymus phasis* Günther.

*Velesionymus* Whitley, in McCulloch, Fish. N.S.W., 3rd ed., 1934, suppl. no. 418—type by original designation and monotypy, *Callionymus limiceps* Ogilby.

*Orbonymus* Whitley, Aust. Zool. 11 1947, p. 150—type by original designation and monotypy, *Callionymus (Calliurichthys) rameus* McCulloch.

There has been no lack of attempts to divide the large genus *Callionymus*, and the synonymy quoted above shows that almost every Australian species has been made into the type of a new genus. None of these attempts, however, has been very successful, and none has met with general approval. As a basis for separation, the shape of the preopercular spine has generally been taken, sometimes also the structure of the dorsal fin (with simple rays or branched rays) and other less obvious peculiarities. However, none of these characters seem to be correlated, they can occur in any combination in any species and their value as a criterion for generic separation is problematical. See further the discussion of *C. calauropomus*.

Obviously any attempt at subdividing the genus *Callionymus sensu lato* that is not based on an examination of at least the great majority of species is worthless, and until a revision on a world wide basis has been carried out, commonsense demands retention of all Australian species in the genus *Callionymus*.

The characters used to separate the species are the familiar ones used by previous workers; the number of rays in the dorsal and anal fins, the shape of the preopercular spine, the length of the snout in comparison to the orbit, etc. Further there is variation in the place of origin of the first dorsal fin, which may, in lateral view, be over the gill openings, or well behind them. A very useful character is whether or not the rays of the second dorsal fin are simple (except the last one) or divided (often with the exception of the first one). I have also used this character, which has the advantage of being very easy to ascertain, in the key, but there is one pitfall: it appears that in some (or all?) species with divided dorsal rays, small individuals have the rays simple. As no small specimens of Western Australian species have been available, I do not know if variation with size is universal; when using the key, however, it will be wise to consider this possibility whenever identifying specimens of less than about 50 mm standard length.

**Key to the Species Known from Western Australia**

- 1a. D IV-7½, A 6½ soft rays of D divided at the tips or simple, preopercular spine with two hooks, no antrorse spine on its base ..... *C. papilio*
- b. D IV-8½ to 10½, A 7½ to 9½ ..... 2
- 2a. All soft rays of D divided, or only first one simple ..... 3
- b. Only last ray of D divided, other rays simple ..... 4
- 3a. D IV-8½ (rarely 9½), A 7½ preopercular spine with two hooks, curved upwards, no antrorse spine on its base ..... *C. calauro-pomus*
- b. D IV-8½, A 7½, preopercular spine more or less straight, with about five fairly small barbules and with an antrorse spine on its base ..... *C. ramcus*
- c. D IV-8½, A 7½, preopercular spine curved upwards at its extremity, with three hooks, no antrorse spine on its base ..... *C. phasis*
- 4a. D IV-9½, A 9½, preopercular spine with two hooks, curved inwards, and with an antrorse spine on its base ..... *C. limiceps*
- b. D IV-9½ (rarely 8½ or 10½), A 9½ (rarely 8½), preopercular spine rather broad, with three to five teeth at tip and on inside, and with an antrorse spine on its base ..... *C. calcaratus*
- c. D IV-9½ (rarely 8½), A 8½ (rarely 7½), preopercular spine straight, spear-like with denticles on the inside and an antrorse spine (covered by skin) on its base ..... *C. grossi*
- d. D IV-8½, A 7½, preopercular spine straight, spear-like, with a number of fine serrations on the inside, and with an antrorse spine on its base ..... *C. goodladi*

**Callionymus calauropomus Richardson**

*Callionymus calauropomus* Richardson, Ichth. Voy. Erebus & Terror, 1844-1848, p. 10, pl. VII Figs. 4 and 5 —"this Australian species," but cf. p. iv where as locality of provenance Western Australia is mentioned.

*Callionymus achates* De Vis, Proc. Linn. Soc. N.S.W. 7, 1883, p. 620—Queensland.

*Callionymus calauropomus*; Günther, Cat. Fish. Brit. Mus. III, 1861, p. 147 (North-west Australia); Castelnau, Proc. Zool. Accl. Soc. Vict. 2, 1873, p. 49 (Hobson's Bay); Günther, Rep. Voy. Challenger, Zool. 1, 1880, Rep. Shore

Fishes, p. 28 (Bass Straits; 38 fathoms); Macleay, Proc. Linn. Soc. N.S.W. 5, 1881, p. 627 (North-west Australia, Port Jackson, Port Phillip); Macleay, Descr. Cat. Aust. Fish. I, 1881, p. 262 (North-west Australia, Port Jackson, Port Phillip); Tenison-Woods, Fish and Fisheries N.S.W., 1883, p. 19 (New South Wales); Lucas, Proc. Roy. Soc. Vict. N.S. 2, 1890 (June), p. 29 (Hobson's Bay); McCoy, Prodr. Zool. Vict., dec. XX, 1890, p. 333, pl. 192 (Hobson's Bay); Woodward in Fraser, W. Aust. Year-Book for 1900-01, I, 1902, p. 271 (N.W. Western Australia); Woodward in Fraser, Notes Nat. Hist. W. Aust. 1903, p. 153 (N.W. Western Australia); Waite, Mem. N.S.W. Nat. Cl. 2, 1904, p. 51 (no locality = New South Wales); Stead, Fish. Aust. 1906, p. 209 (around the coastline of Australia); Oglby, Proc. Roy. Soc. Qd 23, 1910, p. 48 (no locality); McCulloch & Waite, Rec. S. Aust. Mus. 1, 1918, p. 48 (South Australia); Glauert, J. Roy. Soc. W. Aust. 7, (1920-1921), 1921, p. 46 (Western Australia, no definite locality); Waite, Rec. S. Aust. Mus. 2, 1921, p. 142 (no locality = South Australia); McCulloch, Aust. Zool. 2, 1922, p. 103 (Port Jackson); Waite, Fish. S. Aust., 1923, p. 165 Fig. (no locality South Australia); McCulloch, Rec. Aust. Mus. 14, 1923, p. 12 (Port Jackson, also Victoria, New South Wales, and South Australia); McCulloch & Whitley, Mem. Qd Mus. 8, 1925, p. 173 (Queensland); McCulloch, Biol. Res. Endeavour V, 1925, p. 209 (East of Flinders Island, Bass Strait; off Marsden Point, Kangaroo Island, South Australia; Doubtful Island Bay, south-western Australia); McCulloch, Fish. N.S.W., 2nd ed., 1927, p. 77 (Port Jackson); McCulloch, Mem. Aust. Mus. 5, 1929, p. 338 (New South Wales, Victoria, South Australia, Tasmania, Western Australia, Queensland, North-Western Australia, New Ireland); McCulloch, Fish. N.S.W., 3rd ed., 1934, p. 77 (Port Jackson); Whitley, W. Aust. Fish. Dept., Fish. Bull. 2, 1948, p. 27 (Western Australia); E. O. G. Scott, Pap. Roy. Soc. Tasm. 87, 1953, p. 157 (Tamar River, at Launceston, Tasmania); Fowler, Fish. Fiji, 1959, p. 493 (Queensland, North Western Australia, Western Australia, South Australia, Victoria, New South Wales, Tasmania); T. D. Scott, Fish. S. Aust., 1962, p. 169 (Western Australia, South Australia, Victoria, New South Wales and Tasmania).

*Callionymus calauropomus*; Castelnau, Vict. Off. Rec. Philad. Exh. 1875, p. 21 (no locality, presumably Victoria).

*Callionymus achates*; Macleay, Proc. Linn. Soc. N.S.W. 9, 1884, p. 35 (Queensland).

*Foetorepus achates*; Whitley, Aust. Zool. 6, 1931, p. 323 (Queensland).

*Synchiropus calauropomus*; Schultz, Bull. U.S. Nat. Mus. 202, 2, 1960, p. 405 (no locality).

Diagnostic characters. D IV-8½, A 7½, P i.16.i or i.17.i or i.17.ii or i.18.ii, V 1.5, C ii or iii.7.iii; all rays of dorsal fin divided, except sometimes the first one; preopercular spine ending in two hooks, bent upwards, and without an antrorse hook near its base (Fig. 1b); origin of D 1 almost on one line with gill openings; only first ray of pectoral undivided (in one specimen there is no undivided first ray). Males have a long tail and a long anal papilla, females a shorter tail and a short anal papilla.

Distribution. In Western Australia only known from off the south coast, where apparently common. Also known from South Australia, Tasmania, Victoria, New South Wales and south Queensland.

Discussion. Schultz (in Schultz *et al.* 1960), the most recent author to attempt subdivision of the genus *Callionymus*, has placed *C. calauropomus* in *Synchiropus*. A genus, in my opinion, should normally be based on a combination of characters. Schultz (in key, p. 399) uses the following. *Callionymus*: preopercular spine with a basal antrorse spine or one near its ventral edge, all rays of dorsal and of anal fins unbranched except last one in both fins branched to the base. *Synchiropus*: no antrorse spine at base or on ventral side of preopercular spine; first soft dorsal ray usually unbranched, all the

rest branched (except in young), the last one to its base . . ." Thus Schultz uses a combination of only two characters: divided or single dorsal rays, and presence or absence of an antrorse hook on the preopercular spine. But *C. rameus*, of which Schultz says he has studied the description and figure, is placed by him without comment in *Callionymus*, though it has the combination of divided dorsal rays and an antrorse hook, and therefore cuts right across his generic limits. I note that Schultz described one new species as *Synchiropus laddi*, based on specimens of 8-24 mm standard length, though it has simple dorsal rays. While Schultz may be quite right in assuming that larger individuals would have divided dorsal rays, and therefore do come in the genus *Synchiropus* as defined by him, the assignment as it stands seems rather arbitrary and strengthens my doubts about the advisability of recognising the genus *Synchiropus* as defined by Schultz. Not having examined the type species of *Synchiropus*, I confine myself to taking out the Australian species, and prefer not to give an opinion on the validity of the genus as such.

As in Western Australia the species seems strictly limited to the temperate waters off the south coast, it is surprising that elsewhere it should have been recorded from the tropics, from Fiji and New Ireland. While I do not deny the possibility that these records are correct, a re-examination of the material on which some of the older records are based would be desirable to verify if they really pertain to the present species. It may be recalled that, though Richardson described *C. calauropomus* as from Western Australia, Günther (1861) changed this without explanation to North-west Australia—almost certainly in error.

On the east coast of Australia the species ranges apparently farther north than on the west coast. The type of *C. achates*, which was synonymized with *C. calauropomus* by Ogilby (1910) came from Queensland, presumably south Queensland. Admittedly Whitley (1931) resurrected the name, but the characters given by him for its separation are unconvincing. Unfortunately the type of *C. achates* can no longer be found in the collection of the Queensland Museum, but there is a specimen on display, which is recorded as having been obtained off the coast of south Queensland and was received from the Queensland Department of Fisheries on 19th May, 1919 (Mack, in litt.)

Material examined, 14 specimens, varying in standard length from 128 to 189 mm. Michaelmas Island, King George Sound (P 4563), off Limestone Island, King George Sound (P 4803), off Bald Island (P 726 (9 sp.)), between Albany and the Archipelago of the Recherche (P 5412 (3 sp.)). Also examined one specimen from off Yorke Peninsula, South Australia (S. Aust. Mus.), two from Eden, New South Wales (C 714, C 716) and two from Bridgport, Tasmania, the largest of which is 217 mm in standard length (C 2032, C 2033).

#### *Callionymus calcaratus* Macleay

*Callionymus calcaratus* Macleay, Proc. Linn. Soc. N.S.W. 5, 1881, p. 628—Port Jackson.

*Callionymus calcaratus*; Macleay, Descr. Cat. Aust. Fish. I, 1881, p. 263 (Port Jackson); Tenison-Woods, Fish and Fisheries N.S.W., 1883, p. 19 (New South Wales); Ogilby, Proc. Linn. Soc. N.S.W. 10, 1885, p. 121 (Port Jackson); McCulloch, Aust. Zool. 2, 1922, p. 103 (Port Jackson); McCulloch, Rec. Aust. Mus. 14, 1923, p. 10, pl. iii, Fig. 2 (Port Jackson and Houtman's Abrolhos); McCulloch, Biol. Res. Endeavour V, 1926, p. 204 (New South Wales and Houtman's Abrolhos, Western Australia; Queensland waters); McCulloch, Fish. N.S.W., 2nd ed., 1927, p. 77 (Port Jackson); McCulloch, Mem. Aust. Mus. 5, 1929, p. 338 (New South Wales, Western Australia, Queensland); McCulloch, Fish. N.S.W., 3rd ed., 1934, p. 77 (Port Jackson); T. D. Scott, Fish. S. Aust., 1962, p. 168 (Western Australia, South Australia, New South Wales and Queensland).

*Callionymus curvicornis*; Ogilby, Cat. Fish. N.S.W., 1886, p. 37 (Port Jackson); Stead, Proc. Linn. Soc. N.S.W. 25, 1909, p. 476 (Port Jackson); Waite, Mem. N.S.W. Nat. Cl. 2, 1904, p. 51 (no locality—New South Wales); Stead, Fish. Aust., 1906, p. 208 (Port Jackson).

*Callionymus reevesii*; Ramsay & Ogilby, Proc. Linn. Soc. N.S.W. (2) 1, 1886 (1887?), p. 942 (Port Jackson); Waite Mem. N.S.W. Nat. Cl. 2, 1904, p. 51 (no locality—New South Wales).

*Repomucenus calcaratus*; Whitley, Aust. Zool. 6, 1931, p. 323 (no locality); Whitley, W. Aust. Fish. Dept., Fish. Bull. 2, 1948, p. 27 (Western Australia).

*Repomucenus* sp. nov.; Whitley, Aust. Zool. 11, 1945, p. 42 (Shark's Bay).

*Repomucenus calcaratus*; Whitley, Aust. Zool. 11, 1948, p. 275 (Fremantle, the Houtman's Abrolhos, Shark's Bay, between Cape Jaubert and Wallal and even as far as the Northern Territory (Lat. 12°12'S. x Long. 130°36'E.)).

Diagnostic characters. D IV-9½ (rarely 8½ or 10½), A 9½ (rarely 8½), P i.16.ii or i.16.iii or i.17.ii or i.17.iii, V 1.5, C ii.7.iii; only last ray of dorsal fin divided; preopercular spine rather broad, with four or five teeth at tip and on inside, and with an antrorse spine on its base (Fig. 1c); origin of D 1 well behind gill openings; D 1 short, with a black blotch on a white background; only first pectoral ray undivided; eye 1.0 to 1.5 in snout.

Distribution. South Australia, one specimen known, from off Port Lincoln. New South Wales, apparently not uncommon at Port Jackson (Stead 1906), and northern New South Wales (McCulloch 1926). Queensland, mouth of Wide Bay (McCulloch 1926). Western Australia, distribution discussed below.

Discussion. As far as material in the Western Australian Museum is concerned, this is a rare species in the state; there are only three specimens from Shark Bay in our collection. Whitley (in litt., 18.IX.1962) mentions, however, that the Australian Museum has material from a number of localities: two specimens, dredged between Cape Jaubert and Wallal, about five miles offshore in 5 fathoms, September 1929, by Mr. A. A. Livingstone, I.B. 4139-4140; Hampton Harbour, Dampier Archipelago, trawled, 5.IX.1952, by Mr. K. Godfrey, I.B.3061; Exmouth Gulf, August 1952, Mr. K. Godfrey, I.B. 3021; Shark Bay, dredged, July 1939, Mr. G. P. Whitley, I.B. 326; Useless Inlet, Shark Bay, 1939, Mr. G. P. Whitley, I.B. 358; two specimens, Houtman's Abrolhos, received on exchange from the Western Australian Museum in 1905, I. 7239; Fremantle, 1937, Dr. D. L. Serventy, I.A. 7196. Some of these specimens have been mentioned in publications by McCulloch and Whitley. While some of these records are above suspicion, I note that Whitley (1948a) describes for his material a large variation. The fairly large number of specimens of various species examined by me.

points to members of the family being remarkably constant in numbers of finrays. While a variation of one ray does occasionally occur. I find it very difficult to believe that specimens with D IV-8. A 7, as mentioned by Whitley, would really belong to *C. calcaratus*, and a re-examination of the material in the Australian Museum is desirable.

Amongst 19 specimens examined, 17 have D IV-9½, A 9½; one D IV-10½, A 9½; one D IV-8½, A 8½.

Material examined, four specimens varying in standard length from 133 to 154 mm. Off Kok's Island, Shark Bay (C 564), Shark Bay (P 5392, P 5393, P 5409). Also examined 16 specimens from other states, varying in standard length from 25 to 138 mm. Off Yorke Peninsula, S.A. (S. Aust. Mus.), Port Douglas, Q. (A 750), near mouth of Mary River, Q. (A 1061), South Head, Mary River, Q. (A 1142, A 1143, A 1144, A 1145), Tangalooma Point, Moreton Bay, Q. (A 1030), off Point Lookout, Stradbroke Island, Q. (A 1035, A 1036), Tweed Heads, N.S.W. (C 2060), Wallis Lake, N.S.W. (A 861), Princess Royal Harbour, N.S.W. (A 856, A 857), Twofold Bay, N.S.W. (C 2846).

#### *Callionymus goodladi* (Whitley)

*Callinichthys goodladi*: Whitley, Aust. Zool. 10, 1944, p. 270 — Cheyne Beach, Albany district, Western Australia.

*Callinichthys goodladi*: Whitley, W. Aust. Fish. Dept. Fish. Bull. 2, 1948, p. 27 (Western Australia).

Diagnostic characters. D IV-8½, A 7½, P ii.14.i or ii.15.i or ii.15.ii or ii.15.iii or ii.16.i, V 1.5, C ii.7.ii or ii.7.iii; only last ray of dorsal fin divided; preopercular spine straight, spear-like, with about 8-10 small antrorse teeth on the inside, and with near its base a large antrorse spine on the outside (Fig. 1d); snout large, broad and prominent, twice length of eye; origin of first dorsal nearly on a line with gill openings; first and second pectoral rays undivided.

Distribution. As far as hitherto known confined to Western Australia, where recorded from the south coast: Cheyne Beach and near Michaelmas Island, King George Sound, and from the west coast: Cockburn Sound, Shark Bay (entrance to South Passage, and without precise locality) and Exmouth Gulf. This distribution is unusual inasmuch as it includes both tropical and temperate waters.

Material examined, 27 specimens varying in standard length from 81 to 160 mm. Exmouth Gulf (P 4377, P 5355), Shark Bay (P 2541, P 2542, P 2543, P 4360, P 4369 (4 sp.), P 5438, P 5439, P 5440, P 5441, P 5442), entrance to South Passage, Shark Bay (P 4966), Cockburn Sound (A 1359, A 1361, A 1362), Cockburn Sound (A 1340, A 1341, A 1342, A 1343), Michaelmas Island, King George Sound (P 4967), Frenchman Bay (P 5037), between Albany and the Recherche Archipelago (P 5453), Cheyne Beach (P 2528: type of species).

#### *Callionymus grossi* Ogilby.

*Callionymus grossi* Ogilby, Proc. Roy. Soc. Qd. 2, 1919, p. 42—Moreton Bay.

*Callionymus, Callinichthys, nasutus* McCulloch, Biol. Res. Endeavour 7, 1928, p. 167, pl. 14—12 miles south-east from Cape Capricorn, Queensland.

*Callionymus, Callinichthys, grossi*, McCulloch, Rec. Aust. Mus. 14, 1923, p. 8 Cape Moreton; McCulloch & Whitley, Mem. Qd. Mus. 2, 1925, p. 170 Moreton Bay, Cape Moreton; McCulloch, Biol. Res. Endeavour 7, 1928, p. 165 (in key) no locality.

*Callionymus grossi*, McCulloch, Aust. Mus. Mem. 3, 1928, p. 388 Queensland; Schultz, Bull. U.S. Nat. Mus. 269, 2, 1961, p. 493 (no locality); Palmer, Ann. Mag. Nat. Hist. 13, 4, 1962, p. 348 Monte Bello.

*Callionymus Nasutus*, Marshall, Ichthyological Notes Brisbane 1, 1951, p. 5 Moreton Bay off Patus Point.

*Callionymus Callinichthys nasutus*, Mees, W. Aust. Fish. Dept. Fish. Bull. 6, 1969, p. 4 Shark Bay.

*Callinichthys nasutus*: Whitley, Marine Fishes II, 1963, p. 224 no locality.

Diagnostic characters. D IV-9½, A 8½ (in one specimen, 7½), P ii.13.iii or ii.14.ii or ii.15.i, V 1.5, C ii.7.iii; only last ray of dorsal fin divided; preopercular spine straight, spear-like, serrated on the inside with about 10-18 small antrorse teeth, and with on the outside near its base an antrorse spine (Fig. 1e); origin of first dorsal on a line with gill openings, first and second rays of pectoral undivided. Interesting features of this species are that both sexes have the rays of the first dorsal fin elongated; and the sexual dimorphism in snout length (see discussion).

Distribution. Known from Queensland and Western Australia. In Queensland recorded from Moreton Bay (type locality; also Marshall 1951), and from Cape Capricorn (type locality of *nasutus*). Marshall's statement that the type of *nasutus* was trawled off Cape Moreton, South Queensland, must be a slip. In Western Australia the species is known from Shark Bay, Exmouth Gulf and the Monte Bello Islands.

Discussion. One of the main diagnostic features given by McCulloch 1928 in his key to and description of *C. nasutus*, which was based on a single individual, is the long snout. Marshall (1951) had six specimens, and as he makes no comment to the contrary, it can be assumed that they all have a snout much longer than the eye. Two specimens from Shark Bay, reported upon by me (Mees 1969) showed the same feature. Later, however, specimens were received which agreed in every detail with *C. nasutus* but for the fact that they had shorter snouts and a smaller anal papilla. In the long-snouted specimens the anal papilla is large and long (more than half an eye diameter), in the short-snouted specimens it is very small. Though the result of an attempt at sexing was inconclusive, I feel confident that snout-length in this species is a sexual character, the long-snouted fishes being males, the short-snouted females.

I had come as far as this, when I had the opportunity to examine the individual of *C. grossi* recorded by Palmer (1962). This proved to be identical with the specimens which I regarded as females of *nasutus*, and indeed, in McCulloch's (1928, p. 165) key, the only character given to distinguish *C. nasutus* from *C. grossi* is the length of the snout. In order to make quite certain that *C. grossi* and *C. nasutus* are female and male of the same species, I borrowed a type of the former and found my expectations fully confirmed.

Material examined, 20 specimens varying in standard length from 78 to 148 mm. Monte Bello Brit. Mus. Nat. Hist. 1961.8.16.69, Exmouth Gulf (P 5356 3 sp., P 5484, C 2576, C 2579, C 2587, C 2588, C 2589, Exmouth Gulf

or Shark Bay (P 5493), Shark Bay (P 4376 (2 sp.), P 5394, P 5395, P 5396, P 5397, P 5400, P 5447, P 5107). Also examined a specimen from Bulwer, Moreton Bay, Queensland (Queensl. Mus. I 1579; cotype of species), and two specimens from Tangalooma Point, Moreton Bay, Queensland (C 2092, C 2093).

#### *Callionymus limiceps* Ogilby

*Callionymus limiceps* Ogilby, Ann. Qd Mus. 9, 1908, p. 35—Moreton Bay, Queensland.

*Callionymus limiceps* var. *sublaevis* McCulloch, Biol. Res. Endeavour V, 1926, p. 204—7-10 miles north-west of Hummocky Island, near Cape Capricorn, Queensland, 14-16 fathoms, and 13 miles south-east from Cape Capricorn, Queensland, 13 fathoms.

*Callionymus limiceps*; McCulloch, Rec. Aust. Mus. 14, 1923, p. 9 (between Hervey Bay and Port Denison, Queensland, at various depths between 13 and 26 fathoms); McCulloch & Whitley, Mem. Qd Mus. 8, 1925, p. 173 (Moreton Bay; between Hervey Bay and Port Denison); McCulloch, Biol. Res. Endeavour V, 1926, p. 203 (various localities off the coast of southern Queensland); Whitley, Rec. Aust. Mus. 17, 1929 (27 June), p. 115, figs. 3 and 4 (over Sow and Pigs Reef, Port Jackson); McCulloch, Mem. Aust. Mus. 5, 1929 (28 Nov.), p. 340 (Queensland); Schultz, Bull. U.S. Nat. Mus. 202, 2, 1960, p. 4C3 (no locality).

*Callionymus limiceps* var. *sublaevis*; McCulloch, Mem. Aust. Mus. 5, 1929, p. 340 (Queensland).

*Veslionymus limiceps*; Whitley, in McCulloch, Fish. N.S.W., 3rd ed., 1934, suppl. no. 418a (Port Jackson).

Diagnostic characters. D IV-9½, A 9½, P i.14.iii or i.15.i or i.15.ii or i.15.iii or i.16.i or i.16.ii or i.17.i, V 1.5, C ii.7.ii or ii.7.iii; only last ray of dorsal fin divided; preopercular spine with a tip bent inwards, with one antrorse hook on the inside, and with an antrorse spine near its base on the outside (Fig. 1f); only first pectoral ray undivided; origin of first dorsal well behind gill openings. Males have all four rays of first dorsal elongated; there is only a small amount of black on the first dorsal fin; females have a short first dorsal, which is largely black.

Distribution. Queensland, New South Wales and Western Australia. In Queensland the species has been recorded from a number of localities between Hervey Bay and Port Denison; for a full list of localities I refer to McCulloch (1926). For New South Wales there is only Whitley's (1929) record of a single specimen caught at Port Jackson. In Western Australia known from Shark Bay, Exmouth Gulf and the Dampier Archipelago.

Discussion. From the Queensland Museum I received on loan a pair of *C. limiceps*, collected and identified by Ogilby himself; the material from Western Australia differs from these only in having the bony upper surface of the head almost smooth with two slightly elevated radiating centres. This material therefore fully agrees with McCulloch's variety *sublaevis* as figured by Whitley (1929). As there are no other differences, I do not think that *limiceps* and *sublaevis* are different species, and they cannot be recognised as subspecies either, as they co-occur along the Queensland coast.

Material examined, 17 specimens varying in standard length from 53 to 131 mm. Dampier Archipelago (A 1461), Exmouth Gulf (P 5353, P 5354, P 5425, C 2380), Shark Bay (P 4370 (2 sp.), P 5401, P 5402, P 5403, P 5404, P 5405, P 5406, P 5407, P 5408, P 5421 (2 sp.)). Also examined two specimens from Moreton Bay, Queensland (Queensl. Mus. I 487), and one from Tangalooma Point, Moreton Bay, Queensland (A 868).

#### *Callionymus papilio* Günther

*Callionymus papilio* Günther, Ann. Mag. Nat. Hist. (3) 14, 1864, p. 197—Melbourne.

*Callionymus ocellifer* Castelnau, Proc. Zool. Accl. Soc. Vict. 2, 1873, p. 49—Cape Schanck.

*Callionymus lateralis* Macleay, Proc. Linn. Soc. N.S.W. 5, 1881, p. 628—Port Jackson.

*Callionymus nucleayi* Ogilby, Cat. Fish. N.S.W., 1886, p. 37—nomen novum for *Callionymus lateralis* Macleay, nec *Callionymus lateralis* Richardson.

*Callionymus Papilio*; Macleay, Proc. Linn. Soc. N.S.W. 5, 1881, p. 627 (Melbourne); Macleay, Descr. Cat. Aust. Fish. I, 1881, p. 262 (Melbourne).

*Callionymus lateralis*; Macleay, Descr. Cat. Aust. Fish. I, 1881, p. 263 (Port Jackson); Johnston, Pap. Roy. Soc. Tasm. (1890), 1891, p. 33 (Tasmania).

*Callionymus latealis*; Tenison-Woods, Fish and Fisheries N.S.W., 1883, p. 19 (New South Wales).

*Callionymus papilio*; Lucas, Proc. Roy. Zool. Soc. Vict. N.S. 2, 1890, p. 29 (Hobson's Bay); Waite, Mem. N.S.W. Nat. Cl. 2, 1904, p. 51 (no locality — New South Wales);

McCulloch, Aust. Zool. 2, 1922, p. 103 (no locality — New South Wales); Lord, Pap. Roy. Soc. Tasm., (1922),

1923, p. 69 (no locality — Tasmania); McCulloch, Rec. Aust. Mus. 14, 1923, p. 13 (New South Wales, from Port Jackson southward to Victoria and Tasmania); Lord &

H. H. Scott, Synops. Vertebr. Anim. Tasm., 1924, p. 12, 78 (Tasmania); McCulloch, Fish. N.S.W., 2nd ed., 1927,

p. 77 (no locality = New South Wales); Lord in Giblin, Lewis & Lord (editors), Handb. Tasm., 1927, p. 87 (Tas-

mania, especially in the north); McCulloch, Mem. Aust. Mus. 5, 1929, p. 338 (Victoria, New South Wales, Tas-

mania); McCulloch, Fish. N.S.W., 3rd ed., 1934, p. 77 (no locality = New South Wales); E. O. G. Scott, Pap. Roy. Soc. Tasm. 87, 1953, p. 157 (Tasmania); T. D. Scott,

Fish. S. Aust., 1962, p. 168 (South Australia, Victoria New South Wales and Tasmania).

*Footorepus papilio*; Whitley, Aust. Zool. 6, 1931, p. 323 (Victoria); Whitley, Aust. Zool. 11, 1945, p. 42 (Cottesloe);

Whitley, W. Aust. Fish. Dept., Fish. Bull. 2, 1948, p. 27 (Western Australia).

Diagnostic characters. D IV-7½, A 6½, P 18 or 19, V 1.5, C ii.7.iii; first dorsal ray simple, others

divided at the tips; preopercular spine as in *C. calauropomus* pointing outwards and upwards,

with, besides the decurved tip, one single hook, curved forwards, on its inside; no antrorse hook

at its base (Fig. 1g). A small species.

*C. papilio* can easily be distinguished from other Australian species of the genus by the

short dorsal and anal fins, though I note that McCulloch (1923) mentions a specimen that has

eight rays in its dorsal fin instead of the usual seven.

Distribution. New South Wales, Tasmania, Victoria, one record for South Australia (Cape

Elizabeth, Yorke Peninsula), and two specimens recorded from Western Australia (Cottesloe).

The Cottesloe specimens should be in the collection of the Western Australian Museum, but

I have been unable to find them.

Material examined. No material from Western Australia has been available. The only

specimen examined was one of 62 mm standard length from Cape Elizabeth, Yorke Peninsula,

S.A. (S. Aust. Mus. F3076).\*

#### *Callionymus phasis* Günther

*Callionymus phasis* Günther, Voy. Challenger, Zool. I, 1880, p. 28, pl. XV Fig. C—Twofold Bay; 120 fathoms (?).

*Callionymus apricus* McCulloch, Biol. Res. Endeavour V, 1926, p. 209, pl. liv, Fig. 2—Great Australian Bight, south from Eucla, 350-450 fathoms.

*Callionymus phasis*; Macleay, Proc. Linn. Soc. N.S.W. 9, 1884, p. 35 (Twofold Bay); Waite, Mem. N.S.W. Nat. Cl. 2, 1904, p. 51 (no locality — New South Wales);

McCulloch, Aust. Zool. 2, 1922, p. 103 (no locality — New South Wales); McCulloch, Rec. Aust. Mus. 14, 1923, p. 9

\*Amongst our unidentified collections, I have since found a single individual of this species from Salmon

Bay, Rottneest Island, collected 25.II.1955, reg. no. P5691, standard length 52 mm.

(Gippsland Coast, Victoria, 80 fathoms); McCulloch, Biol. Res. Endeavour V, 1926, p. 212 (Gippsland coast, Victoria, 80 fathoms; South of Cape Everard, Victoria, 200 fathoms); McCulloch, Fish, N.S.W., 2nd ed., 1927, p. 77 (no locality = New South Wales); McCulloch, Aust. Mus. Mem. 5, 1929, p. 338 (New South Wales, Victoria); McCulloch, Fish. N.S.W., 3rd ed., 1934, p. 77 (no locality = New South Wales); Norman, Fishes. B.A.N.Z.A.R.E., Rep. (B) I, 1937, p. 56 (off Tasmania, 42°40'S., 148°27'30"E., 122m.).

*Callionymus apricus*; Waite, Rec. S. Aust. Mus. 3, 1927, p. 231 (the Australian Bight in 350 to 450 fathoms); McCulloch, Aust. Mus. Mem. 5, 1929, p. 339 (Border of South and Western Australia).

*Yerutius apricus*; Whitley, Rec. Aust. Mus. 18, 1931, p. 115 (no locality); Whitley, W. Aust. Fish. Dept., Fish. Bull. 2, 1948, p. 27 (Western Australia (south coast)); T. D. Scott, Fish. S. Aust., 1962, p. 170 (Western Australia and South Australia in the Bight).

Diagnostic characters. D IV-8½ or 9½, A 7½; all dorsal rays divided but apparently simple in small specimens; preopercular spine curved upwards at its distal extremity to form a hook of the same size as two others on its upper margin; no antrorse spine at the base below (Fig. 1h). Eyes large, rising high above the profile of the head; interorbital very narrow. Anterior margin of D 1 only a little behind gill openings.

Distribution. Temperate seas of Australia, where known from Twofold Bay, New South Wales; the coast of Victoria, the east coast of Tasmania, and the Great Australian Bight south from Eucla. Apparently a deep water species that has been taken at depths of from 80 to 350-450 fathoms. Recently recorded from Japan (Ochiai, Araga and Nakajima 1955).

Discussion. I have not examined material of this species, which as far as I am aware, in Western Australia is known from the type specimen of *C. apricus* only. The particulars given are after McCulloch (1926), who noted the close resemblance of *C. apricus* to *C. phasis* Günther (1880) and, though not actually saying so, more or less suggested that the two might be identical. Nearly forty years have passed since, and no additional material that might confirm the validity of *C. apricus* has turned up. As the type locality of *C. apricus* is in a region where *C. phasis*, already known from the coasts of New South Wales, Victoria and Tasmania, would be expected to occur, and as both were found in deep water, it seems justified to synonymize the former. McCulloch (1926) mentioned only colour differences to distinguish between the two, but there may well be sexual dimorphism in this character.

All specimens recorded until recently, including the types of *C. phasis* and *C. apricus*, were reported to have divided dorsal rays; their size range was from 48 to 123 mm standard length. In the specimen of 44 mm standard length recently recorded from Japan, the dorsal rays are described as simple.

#### *Callionymus rameus* McCulloch

*Callionymus, Calliurichthys, rameus* McCulloch, Biol. Res. Endeavour V, 1926, p. 201, pl. liii—Cape Capricorn, Queensland.

*Callionymus rameus*; McCulloch, Aust. Mus. Mem. 5, 1929, p. 339 (Queensland); Schultz, Bull. U.S. Nat. Mus. 202, 2, 1960, p. 403 (no locality).

*Orbonymus rameus*; Whitley, Aust. Zool. 11, 1947, p. 150 (no locality).

*Callionymus (Calliurichthys) rameus*; Mees, W. Aust. Fish. Dept., Fish. Bull. 9, 1959, p. 9 (Shark Bay); Palmer,

Ann. Mag. Nat. Hist. (13) 4, 1962, p. 548 (Monte Bello Islands).

Diagnostic characters. D IV-8½, A 7½, P i.15.ii or i.15.iii or i.16.ii or i.17.i or 17.iii or i.18.i, V 1.5, C ii.7.ii to iii.7.iii; all dorsal rays divided or the first ray simple; preopercular spine with about five small teeth on the inside and with an antrorse hook on its base (Fig. 1i); origin of D 1 on a line with the gill openings, only first ray of P simple, once even the first ray divided; snout short, slightly shorter than eye. Apparently no sexual dimorphism.

Distribution. Queensland: Cape Capricorn, also 25 miles south-east from Double Island Point, 33 fathoms, and 4-20 miles north-east of Gloucester Head, 19-35 fathoms (McCulloch 1926). Western Australia: Shark Bay (without exact location) and 40 miles South of Carnarvon (Western Australian Museum); off the Monte Bello Islands (Palmer 1962).

Material examined, 12 specimens varying in standard length from 80 to 153 mm. Various localities in Shark Bay (P 4361, P 5106, P 5267, P 5269, P 5366, P 5413 (2 sp.), P 5414, P 5415, P 5416, P 5431, C 565).

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\*The volume in which Ogilby's article appeared bears the date 1911, but the Royal Society of Queensland pre-issued author's reprints and according to McCulloch (1929-1930), the paper was published in November, 1910.